Mercury Trapped Ion Frequency Standard for GPS

R.L. Tjoelker, E. Burt, S. Chung, R. Glaser, R. Hamell, L. Maleki, J.D. Prestage, N. Raouf, T. Radey, G. Sprague, B. Tucker ,B. Young

Jet Propulsion Laboratory
MS 298-100
4800 Oak Grove Drive
Pasadena, California 91109
USA

We will report on recent activities to develop a flight model of a small, low power, and low mass mercury trapped ion frequency standard leading to a flight demonstration on a GPS satellite. The program goal is to provide 10-100 times improved stability over existing flight standards in a similar clock footprint with a 10 year operational life. The small prototype standard design takes advantage of recent trapped ion frequency standard advances including using a Nitrogen buffer gas for long vacuum pump life [1] and a multi-pole ion trap to nearly eliminate sensitivity to the second order Doppler shift [2]. Recent measurements with a multi-pole trap standard (with no thermal regulation) show an ambient thermal sensitivity less than 2 x 10^{-15}/deg C indicating excellent long term stability can be achieved with only minimal thermal control. The development program, design and tradeoffs, and recent laboratory results will be presented.

[1] « Nitrogen Buffer Gas Experiments in Mercury Trapped Ion Frequency Standards », 2000 IEEE/EIA International Frequency Control Symposium and Exhibition, pp. 668-671, Kansas City, MO June 7-9, 2000.

[2] « Mercury Ion Clock Based On Linear Multipole Ion Trap », 2000 IEEE/EIA Int. Freq. Contr. Symp., pp. 706-710, Kansas City MO, June 7-9, 2000.

This work is being carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Corresponding author:
Robert L. Tjoelker
Jet Propulsion Laboratory
4800 Oak Grove Drive, MS 298-100
Pasadena, CA 91109 USA
Phone 818-354-1873, Fax 818-393-6773
E-mail: Robert.Tjoelker@jpl.nasa.gov